Electrical Manufacturing

ANNOTATED EDITORIAL INDEX

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Basic Statistics for the Design Engineer, James L. Jenkins. An introduction to the mathematical science of statistics. Practical examples illustrate applications of this basic tool in solutions of design engineering problems, particularly in the design of experiments, analysis of data, quality control, operations research and life testing programs. These are but a few of the areas where this mathematical science is earning an increasingly important place in the engineer's "need to know."	May	105

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Slide Rule Mathematics—I, Ira Ritow ..... Mar 97
A definitive, practical treatment of the theory and use of the engineer's prime computing instrument, the slide rule. Includes well-illustrated instructions for the use of all conventional slide rule scales and the circular rule.

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Electronic Materials and Components for Extreme Environmental Problems, A. E. Javitz and P. G. Jacobs ..... Nov 111
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Effect of High Intensity Radiation on Electronic Parts and Materials, C. P. Lascaro and A. L. Long ..... Sep 119
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Ferroelectrics as Solid-State Devices, Richard A. Fotland ..... Mar 130
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Design Factors in Thermostat Selection, Paul Dahlen ..... Nov 140
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Design and Selection of Miniature Sliding Contacts, F. W. Wood, Jr. ..... May 144
An analysis of the complex design problems in the apparently simple sliding contacts employed in control components. Emphasis is on the relations between the exact service required of the contacts, their mechanical design and the materials to be used for optimum performance in a given application.

Brush Choice and Use for Machine Efficiency, W. Siebenmorgen and J. C. Copella ..... Feb 111
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Thermal Relays Perform Unique Functions, J. D. Marks ..... Jan 109
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Effects of Gas Filling on Rectifiers and Thyratrons, J. S. Kirk and A. M. Wohlert ..... Mar 115
The three principle types of filling (inert gas, mercury vapor, or combination) are described. A ready-reference table contrasts the advantages and disadvantages of each type with respect to the tube characteristics that are affected (voltage rating, temperature limits, life, etc.).

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Component Design for Embedded Circuits — A British View, H. G. Mansfield ..... Dec 116

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Design and performance data for regulated fixed/variable d-c constant voltage supplies, for pulse loads such as computers and data processing equipment, using constant voltage transformers, germanium rectifiers and etched aluminum-foil capacitors.

A Low-Level, High-Accuracy, D-C Magnetic Amplifier, Blas A. Mazzeo ..... Nov 106
A description of the design and operation of a magnetic amplifier for measuring—accurately and reliably—d-c signal voltages from transducers such as thermocouples, strain gages, etc.

Magnetic Amplifier Selection by Nomograph, H. H. Hill and F. M. Kinney ..... Oct 80
Advantages of using nomographs for rapid selection of magnetic amplifiers are cited. The derivation and use of this form of graphic portrayal of amplifier parameters are detailed, with supporting specific examples.

Transistor Circuits Alter Magnetic Amplifier Frequency Response, J. C. Taylor and C. L. Wyman ..... Aug 90
A simple and convenient means of employing transistors to shape the dynamic response of self-saturating magnetic amplifiers without disturbing the d-c gain or adding drift problems. Circuit design parameters are included.

British Magnetic Amplifier Developments, D. A. Ramsay and B. W. Glover ..... Jul 56
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Lamination Selection in Choke Design, I. Richardson	May	155
A practical procedure to be used in making the first step in choke design: the selection of lamination type. To be used in conjunction with the complete choke design procedure published in a previous article.		
Static Plug-in Modules for Annunciator System, Staff Report	May	158
An annunciator system for a utilities generating station monitors 560 inputs using encapsulated static control modules. The step-by-step operation of the system is described, including a convenient reference table of the names, symbols, and functions of the more common logic elements.		
Magnetic Pulse Generators, J. E. Sunderlin and M. L. Weinberg	May	139
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Applying the Hall Effect to Practical Magnet Testing, Gerhard R. Hennig	Apr	132
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Designing Minimum Weight Magnetic Cores, J. W. Kallander	Feb	118
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Design Advances from Magnetism Research, William Arrott	Jan	86
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Temperature Rise *vs* Current Rise of Etched Wiring Lines, R. P. Noble	Jul	93
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Combined Analog-Digital Control Systems, M. H. Nothman Where control systems require both the "real-time" characteristics of analog systems and the computational ability of digital computers, the final solution may require computations involving information in both analog and digital form. Practical hybrid circuits described include: analog-to-digital and digital-to-analog converters; multiplication circuits; sine-function generators; the "squaring bridge" and the servo divider.	Jun	78
Analyzing Combinational Circuits by Boolean Matrices and Karnaugh Maps, Boris Beizer and Stephen W. Leibholz Procedures for (1) deriving the boolean function of multi-path switching circuits and (2) visualizing and simplifying the boolean expression for any logical circuit. Second of five articles on "Engineering Applications of Boolean Algebra."	Jun	98
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Automatic Positioning with Punched Tape Control, Staff Report — The punched tape control of the "Fosmatic" Jig Borer is described in detail and basic circuit designs are illustrated. Unique features of the system include stepping switch memory circuits with automatic checking of tape reader accuracy and an automatic gage rod operation for positioning the machine in response to tape commands.	Apr	120
Switching Reactors Combine Control Logic and Power Switching, Edgar V. Weir — Standardized switching reactors for static control of industrial equipment operate contactors and solenoids directly in response to pushbutton and limit-switch signals without additional amplifiers or specialized power supplies. Case histories: index table unloading station; reverse current detector; relay-closure counter; annunciator control; die-casting machine; punch press drive.	Mar	82
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MBS Counting Circuit Controls Numerically Programmed Index Table, C. B. Smith — Jacy precision digital index system uses dual-lead worm and wheel drive to limit maximum mechanical error to 8 sec of arc, repeatable within ± 1 sec. Magnetron beam switching tubes, pulsed by proximity-type transducer, count 1-min increments of table movement to initiate deceleration, stopping and table lock-up at programmed indices.	Mar	138
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Backlash in Servo Systems, R. V. Halstenberg and P. E. Russell — The effect of backlash in servo systems is discussed and described in mathematical terms and the various means of analyzing it are presented. Examples of the use of the frequency response (the best method of analysis) are given.	Dec	96
Design Factors in Thermostat Selection, Paul Dahlen — Functional diagrams and a table of characteristics support a description of the various basic forms of thermostat. The equipment design significance of creep, positive and snap-action contacts, the forms of enclosure and other thermostat details are fully discussed for guidance in selection.	Nov	140
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Fast Response Marks All-Transistor Regulator, B. Berman — The use of semiconductor devices to the exclusion of moving-part components and electron tubes permits the design of a fast and compact regulator for a generator exciter. Complete circuit analysis and operational description are presented.	Oct	82
Non-Linear Transistor Compensation in High-Gain Servo, Staff Report — The design details and application data are given for a compact d-c servo drive unit having broad flexibility in both its electrical and mechanical characteristics. Diode temperature compensation in the transistor amplifier was the key to the efficiency obtained, and the theory of this circuit approach is presented.	Sep	86
Simplified Aircraft Electrical Diagrams, H. L. Yarbrough — Current practice in the aircraft manufacturing industry is compared with a greatly simplified method based on JIC Electrical Standards for Industrial Machinery. Problems created by the use of current graphic methods are cited and arguments given for the adoption of the proposed system.	Sep	95
Dynamic "In-System" Specifications for Control Components, D. D. Pidhayny — A report on proposed application of dynamic system data in the specification of control components by a subcommittee of the AIEE Feedback Control Systems Committee. Discussion includes examples of dynamic tests on typical important components and their meaning to system and component designers.	Aug	72
Transistor Circuits Alter Magnetic Amplifier Frequency Response, J. C. Taylor and C. L. Wyman — A simple and convenient means of employing transistors to shape the dynamic response of self-saturating magnetic amplifiers without disturbing the d-c gain or adding drift problems. Circuit design parameters are included.	Aug	90
The Load-Torque Factor in Precision Gear Backlash, W. Aksamit — Particularly in gear assemblies for instrument and precision applications, backlash is an important question in both design and performance. Analytical and direct-test methods are outlined for segregating the various factors that contribute to total backlash, leading to a general procedure for its evaluation in specific gear-trains.	Aug	98
British Magnetic Amplifier Developments, D. A. Ramsay and B. W. Glover — Beginning with the basic Ramey circuit, various configurations of magnetic amplifiers, some with transistor control, are developed and their uses in practical applications are described. Many circuits are illustrated and the physical construction of some experimental models using the circuits is shown.	Jul	56
Machine-Tool Control Advances, Staff Report — Summary of selected reports presented at the 22nd Westinghouse Machine-Tool Forum. These range from component and system developments to design and maintenance considerations in machine-tool control technology.	Jul	63
Combined Analog-Digital Control Systems, M. H. Nothman — Where control systems require both the "real-time" characteristics of analog systems and the computational ability of digital computers, the final solution may require computations involving information in both analog and digital form. Practical hybrid circuits described include: analog-to-digital and digital-to-analog converters; multiplication circuits; sine-func-	Jun	78

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tion generators; the "squaring bridge" and the servo divider.		
Static Plug-In Modules for Annunciator System, Staff Report	Jun	158
Control Panel Layout to JIC Standards, F. R. Carlson	May	125
Procedures to follow in laying out control panels to meet JIC Electrical Standards. The use of transparent templates in making the drawings is also described.		
Magnetic Pulse Generators, J. E. Sunderlin and M. L. Weinberg	May	139
Pulse generators using saturable reactors as switches overcome power limitations of thyratrons in radar applications. The general circuit principles and pulse forming network design discussed here apply to pulse generating systems for other applications.		
Static Plug-in Modules for Annunciator System, Staff Report	May	158
An annunciator system for a utilities generating station monitors 560 inputs using encapsulated static control modules. The step-by-step operation of the system is described, including a convenient reference table of the names, symbols, and functions of the more common logic elements.		
Crossbar Switch Applications, Kurt Enslein	Apr	86
Now designed to meet severe industrial specifications, crossbar switches are being increasingly applied as control system components. Circuit details are described for: 3-coordinate single-point selection; stepping-switch scanner control; high-speed (magnetron beam switching tube) scanner control; digital-to-analog conversion; analog-to-digital conversion; multiple indexing and switching functions.		
Switching Reactors Combine Control Logic and Power Switching, Edgar V. Weir	Mar	82
Standardized switching reactors for static control of industrial equipment operate contactors and solenoids directly in response to pushbutton and limit-switch signals without additional amplifiers or specialized power supplies. Case histories: index table unloading station; reverse current detector; relay-closure counter; annunciator control; die-casting machine; punch press drive.		
Mag-Amp Relay for Control Systems, V. Hudson	Mar	146
Input Simulation for Servo Test Accuracy, Stanley Handelman	Feb	104
For testing of servo systems and other measurements in which the input signal is a voltage analog of angular position, a resistance network can simulate a high precision synchro or resolver and dividing head. The development of the network, the requirements for the auxiliary null-detection equipment and other uses for the resulting synthesized signal are described.		
Motorized Actuators in Hydraulic Systems, J. Hulman	Jan	74
The addition of a motorized actuator to the conventional hydraulic control system provides a prompt, accurate link between hydraulics and electric monitoring or programming circuits. Several types of electrohydraulic controls and their application are discussed.		
Theory		
Designing Sequential Circuits, Boris Beizer and Stephen W. Leibholz	Sep	67
Analyzing and synthesizing a circuit possessing memory (or whose state depends on "past history" as well as externally applied control) requires deriving not ony the output equations but also a feedback equation for each internal secondary control. Fifth of five articles on the "Engineering Applications of Boolean Algebra."		
Treating Transfer Functions on Analog Computers, C. Beck	Oct	94
A simple, direct method of applying the transfer function of a system to an analog computer to determine the system output is described and examples are given. Applicable to systems initially at rest or those with input conditions. The symmetry of a transfer function expressed in terms of the Laplace operator makes the application to a computer uniquely easy.		
Circuit Design Using Boolean Matrices and System Synthesis Using State Coding, Boris Beizer and Stephen W. Leibholz	Aug	108
Fourth of five articles on the "Engineering Applications of Boolean Algebra."		
Analyzing Specifications and Designing Circuits, Boris Beizer and Stephen W. Leibholz	Jul	100
How to transform a set of requirements into synthesis maps for correcting contradictions or ambiguities, and how to synthesize the boolean functions of the final circuit from the corrected map analyses of the specifications. Third of five articles on "Engineering Applications of Boolean Algebra."		
Analyzing Combinational Circuits by Boolean Matrices and Karnaugh Maps, Boris Beizer and Stephen W. Leibholz	Jun	98
Procedures for (1) deriving the boolean function of multipath switching circuits and (2) visualizing and simplifying the boolean expression for any logical circuit. Second of five articles on "Engineering Applications of Boolean Algebra."		
Language and Laws of Boolean Algebra, Boris Beizer and Stephen W. Leibholz	May	129
Basic concepts of boolean algebra as a system engineer's tool for understanding and designing electrical, mechanical and hydraulic switching systems. First of five separate articles on "Engineering Applications of Boolean Algebra."		
The Anatomy of Automation—II, George H. Amber and Paul S. Amber	Feb	124
Continuing the tabular pattern of Part I, the authors classify automation's "nervous system" and "brain" in Part II. The former is defined by various modes of control, measurement and dimensions, sensing elements, feedback and process sensing. The authors define machine intelligence and delineate "mental" operations that can be performed by machines, including computer type of control.		
The Anatomy of Automation—I, George H. Amber and Paul S. Amber	Jan	78
Systematic approach is made to classify and define automation concepts in four main categories corresponding to the human machine—skeleton, organic structure, nervous system and brain. In Part I, the authors deal with energy and information, automation areas, orders of automaticity, production—as the skeleton. And with modes, objects, agencies, aspects and factors of manufacture—as the organs.		
DESIGN CONSIDERATIONS		
Component Design Factors		
Optimum Shapes for Thermostat-Metal Cantilever Strips, R. M. Sears	Oct	72
Presents details of the interrelated economic, thermal and mechanical factors in the design of thermostat-metal cantilever strips for mechanical and electrical applications. Methods and data are given for analyzing each design aspect, and for combining them for most efficient utilization.		
Foil Coil Design Factors, Theodore Wroblewski	Apr	83
Wafer coil techniques lend themselves to weight reduction of transformers and other inductors, giving greater thermal dissipation per unit of weight than with magnet wire. Advantages of encapsulating coil assemblies separately *vs* whole transformer assemblies cited.		
Stable R-F Transformer Package, D. M. Lisbin	Feb	135
Design of a stable r-f bifilar transformer for conventional or printed wiring systems. Design features an internal printed circuit for coil termination and mounting of components.		

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Human Engineering		
Control Panel Design and Human Engineering 1. *Instrument Design for the Elimination of Errors in Use*, R. Bilinski 2. *Five Elements of a Good Control Panel*, D. R. Witt 3. *Control Knobs for Military Electronic Equipment*, T. G. Nessler Three articles emphasizing the importance of the human engineering approach to successful control panel design.	Sep	110
Reliability Evaluation of the Human Component in Man-Machine Systems, H. L. Williams Designers are invariably faced with the conflicting demands of human and equipment reliability, costs, space, weights, developmental time and other factors. Human reliability in the operation of equipment can be determined, even if only roughly, by the use of probability analysis techniques employed by equipment reliability engineers. A hypothetical case history is presented.	Apr	78
Novel Information Display System, Staff Report Design of a color-coded information display system for control panels and consoles. Up to four colors may be provided in each information display area to depict different bits of information concerning a given operation or device. Applications include annunciator boards, games, utility and process control panels.	Jan	114
Food Waste Liquefier Uses Sound-Damping Fiber-Glass, Staff Report	Jan	124
Materials Selection Factors		
Plastics In Synchro Housing Design and Production, A. S. Weiss Case history of development of cast-epoxy plastic-housed synchro. Included are basic concepts of such a design, materials used, and casting methods employed. Basic production problems are discussed, plus assembly and test methods.	Nov	145
Miniaturization		
Super-Thin Bonded Insulating Films, W. K. W. Chen and W. E. Estey Miniaturization of components in electronic equipment is dependent upon thin, space- and weight-saving dielectrics. Presented are methods of construction and evaluations of bonded insulating films for extremely small size capacitors. The same techniques are applicable to foil coil transformer constructions. Tables and graphs show effective areas of electrical capacitance, dielectric properties and structural strength of the films.	Aug	84
Microminiature Components for Electronic Circuits, N. J. Doctor and E. M. Davies Microminiaturization techniques, utilizing such elements as printed wiring and printed components, uncased diodes and transistors, have achieved significant results in package size reduction. For example, circuit densities up to 2800 components per cu in. have been attained in laboratory models of a binary counter stage as against earlier design with a density of 7 components per cu in.	Aug	94
Designing Minimum Weight Magnetic Cores, J. W. Kallander A straightforward procedure, developed during the design of satellite instrumentation for Project Vanguard, for minimizing the weight of core, case and coil—with provision for also minimizing weight of voltage supply battery and associated components.	Feb	118
Nomographs		
Short Cuts for D-C Magnet Coil Designs, R. R. Taggs	Jan	119
Nuclear Radiation Effects		
Electronic Materials and Components for Extreme Environmental Problems, A. E. Javitz and P. G. Jacobs Extreme environmental conditions, particularly ultrahigh temperatures in excess of 500 C and/or nuclear radiation, are encountered in electronic systems for supersonic aircraft and missiles, submarines, and certain military ground equipment. The ability of commercially available materials and components to withstand these environments is comprehensively surveyed and tabulated. Problem areas are analyzed.	Nov	111
Effect of High Intensity Radiation on Electronic Parts and Materials, C. P. Lascaro and A. L. Long A preliminary report on effects of high intensity radiation on Signal Corps equipment. Components tested were meter switches, relays, capacitors, magnetic devices, transformers, resistors and rectifiers. Materials tested and described were casting resins, filler material, magnesium-manganese ferrite bodies, glass, selenium, silicon and germanium. Text is supported by tabulated material and graphs.	Sep	119
Effects Of Radiation Environment On Structural Metals, A. Boltax The mechanisms of radiation damage are presented, with charts and graphs. Selection and analysis of metals able to withstand harmful effects of radiation without compromising original properties and characteristics, as specified in equipment design, are also presented. The article covers pure metals, structural alloys, and special classes of alloys. Metals discussed include copper, iron, steels, aluminum, nickel and their alloys.	Jun	125
Packaging, Electronic		
Transistorized Computer Modules in Machine Tape Control, P. F. Fischer Design details of the Numill numerical control system (incorporating an optical measuring system with 0.0002-in. resolution) that uses off-the-shelf modules to reduce specialized engineering for a particular application to the design of a wiring harness and selection of drive elements.	Sep	100
The Micro-Module Design Concept in Electronics, A. W. Rogers Expansion applications for electronics in modern military operations make further reductions in size and weight a primary goal for equipment design engineers. Traditional methods of simply scaling down conventional component parts have about reached practical limits. Reasons for the required new approach are outlined in this article, together with a summary of the Signal Corps Micro-Module Program.	Jul	46
Electronic Circuit Packaging for Missile Applications, S. G. Bassler Package design considerations for high shock and high vibration applications. Test results and size and weight efficiencies are described for radial, axial, and planar constructions studied under a Signal Corps development program.	Mar	123
Production Cost		
Specifications Review—A Key to Value Improvement, T. C. Reeves This study discusses equipment specifications as a primary influence on product value. It gives guidance for evaluation and value-improvement of specifications. The practical problem of how to organize for and accomplish a specifications review is discussed, with means for taking appropriate action on the results of the review.	Nov	100
Reliability		
Techniques of Cooling Electronic Equipment—II, J. P. Welsh Concluding article of a two-part series (see November 1958 issue) translates the theory of cooling into practical methods for cooling	Dec	87

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various types of electronic parts and equipments. Heat removal is discussed in relation to electron tubes, rectifiers, transistors, semiconductor devices generally, resistors and transformers. Methods discussed include: forced convection, liquid and vapor cooling, direct liquid coolants, indirect cooling and direct vaporization coolants.		
Techniques of Cooling Electronic Equipment, J. P. Welsh — This basic article on cooling theory and temperature measurement is the first of two to be presented. Included are methods and techniques of temperature measurement and control. The article is supported by charts, graphs and practical illustrations. Explained are types of cooling with their advantages and drawbacks, and the instruments of temperature measurement and control.	Nov	80
Reliable Electrical Connections Conference, Staff Report — A feature of the third EIA Conference on Reliable Electrical Connections will be the absence of the formal presentation of papers. The papers have been published in advance and will only be discussed at the meeting. Six of the papers are abstracted here.	Nov	151
The Space Environment, A Preliminary Study, R. A. Di Taranto and J. J. Lamb — Analysis of natural environments in space (above 75,000 ft) as they affect future equipment design. Anticipated values are established for atmospheric composition, pressure, solar radiation, ozone, dissociated gases, aurorae, ionized gases, solid particles and the earth's magnetic field.	Oct	54
Reliability Evaluation of the Human Component in Man-Machine Systems, H. L. Williams — Designers are invariably faced with the conflicting demands of human and equipment reliability, costs, space, weights, developmental time and other factors. Human reliability in the operation of equipment can be determined, even if only roughly, by the use of probability analysis techniques employed by equipment reliability engineers. A hypothetical case history is presented.	Apr	78
Shock and Vibration		
Food Waste Liquefier Uses Sound-Damping Fiber-Glass, Staff Report	Jan	124
Space and Weight Factors		
Magnesium Parts in Electronic Equipment, H. R. Bullock — Magnesium is being used to solve difficult space-strength-weight problems through its substitution for other metals. Design data in the form of charts and tables are presented to supplement design considerations necessary for lightweight electronic structures. Two case histories of superior design with magnesium are presented. One is a pulse modulator and the other a practical electronic package application.	Jul	50
Gage Modules Advance Machine-Control Design, Staff Report — The adaptation of basic design principles such as modular construction, plug-in components and connections, and sliding-panel circuit subassemblies to gaging instruments and controls is described. Applications of the gages are to machine tools, parts segregation systems and automatic assembly machines.	Jul	110
Redesign Cuts Generator Bulk by a Third, L. T. Loforese	Jul	118
Designing Minimum Weight Magnetic Cores, J. W. Kallander — A straightforward procedure, developed during the design of satellite instrumentation for Project Vanguard, for minimizing the weight of core, case and coil—with provision for also minimizing weight of voltage supply battery and associated components.	Feb	118
Specifications and Standards		
Perforated Storage Media, H. L. Tholstrup — Survey of primary punched tape and card systems: early development, current media formats and dimensions, compatibility problems, standardization progress, sources of perforated record equipment.	Dec	53
Further Progress in International "Rules" on Controlgear, G. W. Heumann — Progress report on steps taken at the 1958 International Electrotechnical Commission meeting in Stockholm to develop "Rules" for controlgear. Areas discussed include: temperature rise, dielectric tests, clearance and creepage distances and enclosures.	Dec	114
Specifications Review—A Key to Value Improvement, T. C. Reeves — This study discusses equipment specifications as a primary influence on product value. It gives guidance for evaluation and value-improvement of specifications. The practical problem of how to organize for and accomplish a specifications review is discussed, with means for taking appropriate action on the results of the review.	Nov	100
International Developments in Insulation Standards, J. F. Dexter — Report by a member of the United States delegation on the 1958 International Electrochemical Commission meetings dealing with test procedures and standards for electrical insulation. Proposed revisions and new standards are discussed.	Oct	76
Purged Enclosures for Hazardous Atmospheres, H. C. Pratt — Presents the case for using NEMA 12 enclosures, slightly pressurized by a remote blower, in Class 1, Group D locations usually requiring explosion-proof or pressurized inert-gas enclosures to guard against inflammable or explosive dust or gases being ignited by arcing of electrical contacts.	Oct	112
Simplified Aircraft Electrical Diagrams, H. L. Yarbrough — Current practice in the aircraft manufacturing industry is compared with a greatly simplified method based on JIC Electrical Standards for Industrial Machinery. Problems created by the use of current graphic methods are cited and arguments given for the adoption of the proposed system.	Sep	95
Dynamic "In-System" Specifications for Control Components, D. D. Pidhayny — A report on proposed application of dynamic system data in the specification of control components by a subcommittee of the AIEE Feedback Control Systems Committee. Discussion includes examples of dynamic tests on typical important components and their meaning to system and component designers.	Aug	72
Electronic Standards for Industrial Equipment, Plant Engineering Electronics Committee, General Motors Technical Center — To be used in conjunction with the Joint Industry Conference (JIC) Electrical Standards for Industrial Equipment, these General Motors electronic standards are being disseminated as an aid to the maker of electronic equipment for heavy industry.	Aug	121
Temperature Rise *vs* Current Rise of Etched Wiring Lines, R. P. Noble — A preliminary study of the current-carrying characteristics of etched (printed) wiring lines. The basic theory of the subject is presented. Although the general theory applies to all plastics laminates used as printed-wiring boards, this first phase is concerned only with the epoxy-glass laminates. The temperature rise *vs* current rise for various sizes of lines has been determined. Recommendations for future temperature rise studies are detailed.	Jul	93

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Standard Test Panel for Printed-Wiring Boards, LeRoy Cota, C. C. Petersen and F. D. Turner Description of specially developed specifications and associated test panel for the procurement of high-quality printed wiring boards for exacting military requirements. Only epoxy-glass laminate is permitted as base material. Conductive surface is required to have gold-plated finish.	Jul	98
An Evaluation of the New "Industrial" D-C Motors and Generators, B. M. Emunson and A. J. Ward Commercial designs resulting from adoption of NEMA Suggested Standards for Future Design of Industrial D-C Motors and Generators (latest revision November 14, 1957) are compared with old general-purpose designs. Lower rotor inertias and improved design have led to much faster response for today's cyclical drives using variable-voltage systems derived from unit generators.	Jun	92
Design by Test and Analysis Spurs Relay Progress, Arnold E. Rudahl Rational methods of relay design, and various means for deriving empirical data for design of relay magnetic and mechanical structures and for contact selection, were emphasized at the Sixth Annual Relay Symposium, Oklahoma University. Numerous specific relay designs were also described. Activating committees under NARM sponsorship are to push standardization and common terminology.	June	134
Control Panel Layout to JIC Standards, F. R. Carlson Procedures to follow in laying out control panels to meet JIC Electrical Standards. The use of transparent templates in making the drawings is also described.	May	125
The Anatomy of Automation—II, George H. Amber and Paul S. Amber Continuing the tabular pattern of Part I, the authors classify automation's "nervous system" and "brain" in Part II. The former is defined by various modes of control, measurement and dimensions, sensing elements, feedback and process sensing. The authors define machine intelligence and delineate "mental" operations that can be performed by machines, including computer type of control.	Feb	124
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Thermal Design Factors		
Techniques of Cooling Electronic Equipment—II, J. P. Welsh Concluding article of a two-part series (see November 1958 issue) translates the theory of cooling into practical methods for cooling various types of electronic parts and equipments. Heat removal is discussed in relation to electron tubes, rectifiers, transistors, semiconductor devices generally, resistors and transformers. Methods discussed include: forced convection, liquid and vapor cooling, direct liquid coolants, indirect cooling and direct vaporization coolant.	Dec	87
Techniques of Cooling Electronic Equipment, J. P. Welsh This basic article on cooling theory and temperature measurement is the first of two to be presented. Included are methods and techniques of temperature measurement and control. The article is supported by charts, graphs and practical illustrations. Explained are types of cooling with their advantages and drawbacks, and the instruments of temperature measurement and control.	Nov	80
Electronic Materials and Components for Extreme Environmental Problems, A. E. Javitz and P. G. Jacobs Extreme environmental conditions, particularly ultrahigh temperatures in excess of 500 C and/or nuclear radiation, are encountered in electronic systems for supersonic aircraft and missiles, submarines, and certain military ground equipment. The ability of commercially available materials and components to withstand these environments is comprehensively surveyed and tabulated. Problem areas are analyzed.	Nov	111
Effects of Temperature on Magnetic Properties of Nickel-Iron Alloys, J. F. Fritz and J. J. Clark Normal magnetization curves, saturation induction, remanence and coercivity measurements at both increasing and decreasing temperatures in the —60 to +250 C range for: Hipernik V, Hipernik, Deltamax, Mo-Permalloy, Supermalloy and Hymu 80.	Nov	135
Non-Linear Transistor Compensation in High-Gain Servo, Staff Report The design details and application data are given for a compact d-c servo drive unit having broad flexibility in both its electrical and mechanical characteristics. Diode temperature compensation in the transistor amplifier was the key to the efficiency obtained, and the theory of this circuit approach is presented.	Sep	86
High Voltage Transistor Regulated Power Supplies, M. Mamon Applications for silicon and germanium transistors as voltage regulators. Circuit analysis and step-by-step design procedure including considerations of temperature effects on Zener reference diodes and on transistor stability.	Sep	106
Heat Resistant Laminate For Supersonic Airborne Equipment, F. W. Jahns, Jr. A preliminary evaluation of new types of felted asbestos-base phenolic laminates developed to cope with severe structural-heat problems in systems and components design.	Jan	84
DRIVES		
Electrical		
Two-Speed Drive + Positioning with New Step Motor, S. Noodleman Electrical and magnetic operating principles of a rugged step motor for direct power drive and positioning are presented. The versatility of the development is indicated by selected examples of specific applications of the step motor and its auxiliary apparatus.	Dec	66
Rugged Adjustable Speed Drives Use Magnetic Amplifiers, V. W. Press and W. R. Jones	Nov	152
Comparison of Drive-Regulator Basic Types, A. R. Sween	Aug	126
Electronic A-C Adjustable Speed Drive, C. Marx and H. Dessmer	May	148
Development of Drives for Wire Drawing Machines, M. A. Nye and R. C. Suttle The development of motor controls for wire drawing machines is traced from individually motorized and controlled blocks to multiple-generator, integrated control of continuous operation. An up-to-date system with modular construction of the control system is described.	Mar	93
Dual-Function Motor is End-Mounted on Lathe, Staff Report	Feb	149
GENERATORS		
Power		
Fast Response Marks All-Transistor Regulator, B. Berman The use of semiconductor devices to the exclusion of moving-part components and electron tubes permits the design of a fast and compact regulator for a generator exciter. Complete circuit analysis and operational description are presented.	Oct	82

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INSTRUMENTS AND TEST EQUIPMENT

Applications

Radio Noise Measurement, H. J. Tyzzer ..... Nov 93
Conducted and radiated interference measurements, instrument characteristics and response standards are reported for a series of radio noise meters.

Control

Novel Information Display System, Staff Report Jan 114
Design of a color-coded information display system for control panels and consoles. Up to four colors may be provided in each information display area to depict different bits of information concerning a given operation or device. Applications include annunciator boards, games, utility and process control panels.

Design

Automatic Analyzer Identifies Circuit Faults, Staff Report ..... Oct 91
Circuit checker design provides high-speed cable harness testing with numerical readout of circuits at fault. Versatility of basic design provides for expansion and adaptability. Unitized program system permits functional testing and multiple-tie programming.

Automatic Life Testing and Data Recording, Stephen Foldes ..... Jun 144
Design of a flexible and highly automated component life test set. Description of program timing, specimen selection, and automatic digital print-out of four measured variables.

R-F Permeameter Techniques for Testing Ferrite Cores, A. L. Rasmussen and A. E. Hess ..... May 86
Equipment, equations and typical results for testing toroidal samples of commercially available ferromagnetic materials; complex initial permeability measurements over frequency range 20 kc to 50 mc; temperature dependence of r-f permeability measurements from room temperature to over 275 C; and reversible permeability measurements with parallel d-c biasing fields up to 12 oersteds.

Automatic Memory-Core Handler Uses Magnetic Feed, R. O. Endres ..... May 152

Transistors in Measuring Instruments, 1. E. J. Peterman, 2. Staff Report ..... Feb 140
1. *Millivoltmeter Features Hybrid Augmented Cathode Follower.* A new a-c millivoltmeter, utilizing a unique combination of vacuum tube and transistor in the input stage, is described in detail, including complete schematic diagram of circuit.
2. *Clamp-Type Microammeter Developed for High Frequencies.* Applying the principle of measuring current without interrupting the circuit to low-level high-frequency circuits is discussed and the design of a transistorized amplifier for such a meter is given.

Thyrite Bridge Applications, G. D. Barcus, Jr. ..... Jan 64
Design data for non-linear resistance bridge circuits using Thyrite resistors. Applications include phase inversion, frequency multiplication, and voltage regulation.

Automatic Testing, Data Recording, and Statistical Analysis System, E. Hoo ..... Jan 104
Description of the Astramatic system designed for automatic handling, testing, sorting of components, and automatic accumulation and analysis of statistical data. Test data are recorded on punched tape and automatically plotted as a histogram.

MATERIALS, ELECTRICAL/ELECTRONIC

Electronic Materials and Components for Extreme Environmental Problems, A. E. Javitz and P. G. Jacobs ..... Nov 111
Extreme environmental conditions, particularly ultrahigh temperatures in excess of 500 C and/or nuclear radiation, are encountered in electronic systems for supersonic aircraft and missiles, submarines, and certain military ground equipment. The ability of commercially available materials and components to withstand these environments is comprehensively surveyed and tabulated. Problem areas are analyzed.

Conductor Materials

Conductive Adhesive for Electronic Applications, T. J. Kilduff and A. A. Benderly ..... Jun 148
A silver-epoxy resin formulation, when heated at 100 C for 1 hr, has a volume resistivity of approximately 0.5 ohm-cm and produces bond strengths greater than 4000 psi. Cured at lower temperatures, the adhesive shows increased volume resistivity. It finds use for diverse mechanical and electrical connections between dissimilar materials; also for repair of printed wiring.

Structural and Electrical Applications of Aluminum in Europe, Staff Report ..... May 76
A survey evaluating and illustrating European engineering experience with aluminum in research, development and manufacturing of electrically energized equipment. Material is based on papers presented at a symposium sponsored by the British Aluminium Development Association in London during May, 1957.

Transparent Electrically Conductive Coating, E. R. Olson and E. H. Lougher ..... Mar 143
A new procedure for depositing a highly transparent, electrically conductive coating that may be applied at low temperatures. The process utilizes high-vacuum technics with a simultaneous evaporation of tin and indium in an oxygen-rich atmosphere. The vaporized metals are deposited on prepared materials and heat treated in air. The process is controlled and monitored to give preferred electromechanical properties.

Contact Materials

Design and Selection of Miniature Sliding Contacts, F. W. Wood, Jr. ..... May 144
An analysis of the complex design problems in the apparently simple sliding contacts employed in control components. Emphasis is on the relations between the exact service required of the contacts, their mechanical design and the materials to be used for optimum performance in a given application.

Brush Choice and Use for Machine Efficiency, W. Siebenmorgen and J. C. Copella ..... Feb 111
The general properties and scopes of application of various types of electrical brush materials are outlined, together with considerations of brush size and shape details. Brush mounting and connection accessories in their various forms are also described, with the reasons for their development and use.

Electrical Insulation and Dielectrics

Dielectric Properties of Reinforced Plastics at Elevated Temperatures, I. Katz and J. Goldberg ..... Dec 72
A tabulation and evaluation of available data on the dielectric properties of reinforced plastics materials at temperatures up to 500 C. Summary of the effect of resin properties, types of reinforcement and fabrication techniques is included. Subject-classified bibliography.

Blister Testing of Magnet Wire, G. W. Recktenwald and R. A. Sellers ..... Nov 158

International Developments in Insulation Standards, J. F. Dexter ..... Oct 76
Report by a member of the United States delegation on the 1958 International Electrochemical Commission meetings dealing with test procedures and standards for electrical insulation. Proposed revisions and new standards are discussed.

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Gaseous Dielectric Materials — Applications and Test Methods, M. L. Manning and E. D. Padgett	Oct	86
Application areas for gaseous (dry) dielectrics are tabulated. Fluorogases are briefly reviewed. Existing test methods for measuring breakdown voltage are described. A new high-temperature test cell is discussed and various breakdown data are presented and interpreted.		
Super-Thin Bonded Insulating Films, W. K. W. Chen and W. E. Estey	Aug	84
Miniaturization of components in electronic equipment is dependent upon thin, space- and weight-saving dielectrics. Presented are methods of construction and evaluations of bonded insulating films for extremely small size capacitors. The same techniques are applicable to foil coil transformer constructions. Tables and graphs show effective areas of electrical capacitance, dielectric properties and structural strength of the films.		
The Molecular Key to Dielectric Properties . . . a Capsule Physical Chemistry for the Design Engineer, T. D. Callinan and A. E. Javitz	Jul	72
The equipment engineer has a "need to know" the physical chemistry of engineering materials so as to properly evaluate and apply them. The basic principles are common to all materials but are related here principally to dielectrics. Gaseous, liquid, and solid dielectrics are discussed, with emphasis on the physico-chemical effects on dielectric properties.		
Glass-Flake Paper—A New Electrical Insulation Material, M. P. Koerner, Jr., and L. M. Conklin	Jun	87
Thin flexible materials can be made with glass-flake structures that offer superior physical and dielectric properties compared to glass-fiber materials. Typical evaluation data are discussed. Molding compounds and rigid laminates are also described.		
Plastics and Ceramic Foams for Electronic Applications, William R. Cuming	May	100
Combination of light weight and excellent dielectric properties has opened up an increasing area of application for plastics and ceramic foam materials in electronic equipment design. Various types of foams are discussed and application methods are described. Property data are included for typical compounds. Selected case histories are illustrated.		
Vacuum-Molded Epoxy Cast-Resin Applications, H. R. Lucas	Apr	98
Design of instrument transformers is improved through application of an integrally molded and impregnated epoxy resin insulation structure. Details of a low-pressure vacuum-molding technique are given and the advantages summarized.		
Thermal Evaluation of Electrical Insulation as a Design Tool, J. F. Dexter	Mar	88
Major procedures for evaluating thermal stability of electrical insulating materials to meet design requirements are discussed in terms of materials tests, systems tests and equipment tests. Development of standard test procedures is traced; significance of various functional tests is analyzed. Typical test procedures are described for various classes of insulating materials.		
Ferroelectrics as Solid-State Devices, Richard A. Fotland	Mar	130
An easy-to-read but concise summary of types, properties, mechanisms and applications of nonlinear dielectrics as: capacitors, transducers, resonant and nonresonant amplifiers, ferroelectroresonant switches, memory devices.		
Evaluation and Applications of Fiber-Insulated Magnet Wire, H. L. Saums and W. W. Pendleton	Feb	93
Complete spectrum of fibrous, film and composite magnet wire insulation is reviewed as complement to previous article by same authors on enameled magnet wire (October 1957, page 129). Characteristics are listed, advantages and disadvantages of various types are compared, and applicable areas of use are listed. Insulations discussed include nylon yarn, polyster yarn, asbestos paper, glass fibers, polyester film.		
Microwave Properties of Solid Dielectrics up to 3000 F, D. M. Bowie	Feb	144
Article describes measurement of dielectric constant and loss of solid dielectric at 3000 mc/sec with apparatus able to yield nearly uniform accuracy from room temperature to 3000 F. Measurements on high-alumina materials show practical temperature limits of operation as dielectrics at the frequency employed. Results on thermosetting laminates indicate temperature limits above which irreversible changes in dielectric properties occur.		
Stable R-F Transformer Package, D. M. Lisbin	Feb	135
Design of a stable r-f bifilar transformer for conventional or printed wiring systems. Design features an internal printed circuit for coil termination and mounting of components.		
Design Factors in Using MgO in Heaters, G. E. Price	Feb	150
Irradiated Polyethylene Insulation Systems, K. J. Mackenzie and R. A. Ward	Jan	56
Electron-irradiated polyethylene tape has been evaluated for its electrical characteristics. Certain advantages, including stability over a wide temperature range, indicate application in various insulation systems. Tests results are analyzed for specific use of the material in wire and cable structures and in motor and generator insulation systems. Ability of the tape material to form a watertight encapsulated sheath is discussed. (See correction — March 156.)		

Magnetic Materials

Effects of Temperature on Magnetic Properties of Nickel-Iron Alloys, J. F. Fritz and J. J. Clark	Nov	135
Normal magnetization curves, saturation induction, remanence and coercivity measurements at both increasing and decreasing temperatures in the —60 to +250 C range for: Hipernik V, Hipernik, Deltamax, Mo-Permalloy, Supermalloy and Hymu 80.		
Magnetic Properties of Stainless Steels, W. S. Eberly	Sep	90
Practical tips on selecting a corrosion-resistant steel with particular magnetic (or non-magnetic) properties for structural and magnetic applications. Characteristics of austenitic, ferritic and martensitic alloys are compared.		
Ferrites for High-Power R-F Tuning, P. P. Lombardini and R. F. Schwartz	Aug	60
An evaluation of commercially available ferrites for power tuning application in the 2.5 to 30 megacycle range: (1) magnetic permeability and Q for samples (both demagnetized and under bias) as a function of frequency, r-f flux and temperature; (2) dielectric constant and Q_D as a function of frequency and electric field intensity; (3) recommendations for future data to be supplied by ferrite manufacturers.		
R-F Permeameter Techniques for Testing Ferrite Cores, A. L. Rasmussen and A. E. Hess	May	86
Equipment, equations and typical results for testing toroidal samples of commercially available ferromagnetic materials; complex initial permeability measurements over frequency range 20 kc to 50 mc, temperature dependence of r-f permeability measurements from room temperature to over 275 C, and reversible permeability measurements with parallel d-c biasing fields up to 12 oersteds.		
Design Advances from Magnetism Research, William Arrott	Jan	86
Recent developments in: soft magnetic alloys for power applications; permanent magnet de-		

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sign; thin magnetic films and other elements for computer memory devices; ferrites, garnets, microwave techniques and magneto-optics—as revealed at the 1957 AIEE Conference on Magnetism.		

MATERIALS, MECHANICAL/STRUCTURAL

Adhesives

Conductive Adhesive for Electronic Applications, T. J. Kilduff and A. A. Benderly A silver-epoxy resin formulation, when heated at 100 C for 1 hr, has a volume resistivity of approximately 0.5 ohm-cm and produces bond strengths greater than 4000 psi. Cured at lower temperatures, the adhesive shows increased volume resistivity. It finds use for diverse mechanical and electrical connections between dissimilar materials; also for repair of printed wiring.	Jun	148

Composite Materials

Synthetic-Fiber and Wool Felts—Their Design Characteristics and Uses, T. J. Gillick, Jr. A comprehensive review of a new class of engineering materials including natural-wool, synthetic-fiber and composite felt materials used in design of electrically energized equipment. Classifications covered are different types of felts and their uses, mechanics of natural and artificial felting procedures, metallic and nonmetallic combinations, physical and chemical data charts and curves, and some experimental materials for future use.	Apr	126

Metals

Designing With Stainless Steel, Staff Report Presented are the properties of stainless steel of significance in equipment design. Important applications, including appliances, instruments, heavy and light machinery, computers and electronic products are illustrated. Some case histories and a stainless steel selector chart are also presented.	Dec	79
Titanium—Its Properties and Design Potentials, H. E. Barkan Presented are current and potential structural and electronic uses for titanium and its alloys in component and equipment design. The physical and electrical properties of standard and new alloys, with fabrication data supported by charts and graphs, are discussed.	Oct	100
Magnetic Properties of Stainless Steels, W. S. Eberly Practical tips on selecting a corrosion-resistant steel with particular magnetic (or non-magnetic) properties for structural and magnetic applications. Characteristics of austenitic, ferritic and martensitic alloys are compared.	Sep	90
Magnesium Parts in Electronic Equipment, H. R. Bullock Magnesium is being used to solve difficult space-strength-weight problems through its substitution for other metals. Design data in the form of charts and tables are presented to supplement design considerations necessary for lightweight electronic structures. Two case histories of superior design with magnesium are presented. One is a pulse modulator and the other a practical electronic package application.	Jul	50
Effects Of Radiation Environment On Structural Metals, A. Boltax The mechanisms of radiation damage are presented, with charts and graphs. Selection and analysis of metals able to withstand harmful effects of radiation without compromising original properties and characteristics, as specified in equipment design, are also presented. The article covers pure metals, structural alloys, and special classes of alloys. Metals discussed include copper, iron, steels, aluminum, nickel and their alloys.	Jun	125
Structural and Electrical Applications of Aluminum in Europe, Staff Report A survey evaluating and illustrating European engineering experience with aluminum in research, development and manufacturing of electrically energized equipment. Material is based on papers presented at a symposium sponsored by the British Aluminium Development Association in London during May, 1957.	May	76

Nonmetallic Materials

Synthetic-Fiber and Wool Felts—Their Design Characteristics and Uses, T. J. Gillick, Jr. A comprehensive review of a new class of engineering materials including natural-wool, synthetic-fiber and composite felt materials used in design of electrically energized equipment. Classifications covered are different types of felts and their uses, mechanics of natural and artificial felting procedures, metallic and nonmetallic combinations, physical and chemical data charts and curves, and some experimental materials for future use.	Apr	126
Foamed Plastics for Structural Functions in Electronic Equipment, R. Thielman Foam plastics are used effectively in designing airborne electronic equipment required to withstand severe natural and induced environments. With particular emphasis on severe dynamic environments, this article analyzes design factors related to vibration; evaluates foam materials as structural and mechanical elements; cites case histories such as the use of foam sandwich structures for mounting boards.	Jan	67
Heat Resistant Laminate For Supersonic Airborne Equipment, F. Jahns, Jr. A preliminary evaluation of new types of felted asbestos-base phenolic laminates developed to cope with severe structural-heat problems in systems and components design.	Jan	84

Protective Coatings

Electrically Conductive Chromate Surface Conversion Coatings, R. Stricklen Metal finishes with good non-porous anti-corrosion properties, high strength and flexibility, and good electrical conductivity are described. Together with substantiating electrical and physical test data, comparative studies of other finishes and typical design applications of these coatings are presented.	Feb	106

Thermal and Acoustical Insulation

Food Waste Liquefier Uses Sound-Damping Fiber-Glass, Staff Report	Jan	124

MOTORS

Fractional-Horsepower

FHP Motors Redesigned to Cut Installation, Maintenance Costs, Staff Report	Sep	122
Gasoline-Submersible Motor Designed for Compactness, E. C. Briggs	Jun	156
Brush Choice and Use for Machine Efficiency, W. Siebenmorgen and J. C. Copella The general properties and scopes of application of various types of electrical brush materials are outlined, together with considerations of brush size and shape details. Brush mounting and connection accessories in their various forms are also described, with the reasons for their development and use.	Feb	111

Integral-Horsepower

Duty-Cycle Motor Selection, G. C. Morris A clear, easy-to-follow method of selecting motors for special duty-cycle applications—an increasingly recurrent problem for the equipment designer. Included is a mathematical analysis of the motor equivalent circuit.	Nov	103
Built-In Overheat Protection for Three-Phase Motors, V. G. Vaughan and R. M. Glidden The design objectives in the development of thermostatic built-in protectors for three-phase	Aug	79

motors are outlined. Results of tests comparing motor temperatures under various load conditions and using both built-in and remote-relay protection are shown. The discussion includes application aspects and advantages of built-in protection.

An Evaluation of the New "Industrial" D-C Motors and Generators, B. M. Emunson and A. J. Ward ..... Jun 92
Commercial designs resulting from adoption of NEMA Suggested Standards for Future Design of Industrial D-C Motors and Generators (latest revision November 14, 1957) are compared with old general-purpose designs. Lower rotor inertias and improved electrical design have led to much faster response for today's cyclical drives using variable-voltage systems derived from unit generators.

Direct-Drive Motor Designed for Stepless Wide Speed Range, Staff Report ..... May 96
The electrical and mechanical design problems are described for a continuously adjustable wide speed range direct drive for a profile milling machine. A first in design, the special d-c motor is of the shell type with water cooling jacket and other innovations. The control system required to achieve the desired characteristics is also outlined.

Electronic A-C Adjustable Speed Drive, C. Marx and H. Dessmer ..... May 148

International Standards for Motor Dimensions Set for Final Approval, M. S. Hancock ..... Mar 118
Compromises achieved in I.E.C. meeting result in relative interchangeability between inch and metric dimensional standards for motors. Problems encountered and tables of final proposed standards are presented.

Brush Choice and Use for Machine Efficiency, W. Siebenmorgen and J. C. Copella ..... Feb 111
The general properties and scopes of application of various types of electrical brush materials are outlined, together with considerations of brush size and shape details. Brush mounting and connection accessories in their various forms are also described, with the reasons for their development and use.

Special

Two-Speed Drive + Positioning with New Step Motor, S. Noodleman ..... Dec 66
Electrical and magnetic operating principles of a rugged step motor for direct drive and positioning are presented. The versatility of the development is indicated by selected examples of specific applications of the step motor and its auxiliary apparatus.

PRODUCT DESIGN CASE HISTORY

Electronic Apparatus

Frequency-Division System for Pushbutton Telephone, L. A. Meacham, J. R. Power and F. West ..... Nov 88
Multi-frequency code signaling is used in an experimental development of a switching system for telephone circuits. Combined tone ringing and pushbutton calling are made possible by circuits employing transistors and ferrite coils. The system and information theory involved are fully outlined.

Thermal Relays Perform Unique Functions, J. D. Marks ..... Jan 109
A detailed description of the working principles and internal design of three basic types of thermal relays having different operating characteristics. Bimetals were avoided, and all-metal scaled construction with external adjustment was achieved in the new designs. Unique properties of precision thermal relays are translated into specific circuit functions.

Industrial Machinery

Power Positioning and Control for Machine Flexibility and Safety, Staff Report ..... Dec 101
Electrical and mechanical details are shown for an overall new design for a wood and metal industrial cutting machine. Unified forms, strategically located controls and high-visibility indicators are combined with safety and convenience features such as power-operated raising and lowering of machine cutting blade.

Gage Modules Advance Machine-Control Design, Staff Report ..... Jul 110
The adaptation of basic design principles such as modular construction, plug-in components and connections, and sliding-panel circuit subassemblies to gaging instruments and controls is described. Applications of the gages are to machine tools, parts segregation systems and automatic assembly machines.

Direct-Drive Motor Designed for Stepless Wide Speed Range, Staff Report ..... May 96
The electrical and mechanical design problems are described for a continuously adjustable wide speed range direct drive for a profile milling machine. A first in design, the special d-c motor is of the shell type with water cooling jacket and other innovations. The control system required to achieve the desired characteristics is also outlined.

Miscellaneous

Printed Circuits in New Telephone Design, M. Farr ..... Apr 96
The use of printed circuits and contemporary materials together with close collaboration with professional appearance designers to accomplish specific product-development targets is outlined. The objectives were lower cost and greater market appeal for a completely fresh version of the familiar telephone set.

Light Energizes Control in Self-Setting Camera, J. P. Bagby and M. W. LaRue, Jr. ..... Jan 101
In order to extend the principle of light-actuated and fully automatic exposure control to the popular 8-mm movie camera, a new operating principle was demanded for the necessarily small and light mechanism. The mechanical and electrical details are described, related to camera optics and the product-design requirements for ruggedness and low cost.

PRODUCTION AND ASSEMBLY TECHNIQUES

Embedded Circuits and Components

Plastics In Synchro Housing Design and Production, A. S. Weiss ..... Nov 145
Case history of development of cast-epoxy plastics-housed synchro. Included are basic concepts of such a design, materials used, and casting methods employed. Basic production problems are discussed, plus assembly and test methods.

Processing System for Optimum Design Use of Casting Resins, W. A. Gammel, Sr. ..... Sep 80
Difference between failure and success in a circuit resin embedment or components encapsulation may lie in the selection and proper use of the optimum resin-handling system. Various commercial machines are described. Associated data on molds and on working environments are provided. Costs of batch, semi-automatic and automated processes are compared.

Plastics and Ceramic Foams for Electronic Applications, William R. Cuming ..... May 100
Combination of light weight and excellent dielectric properties has opened up an increasing area of application for plastics and ceramic foam materials in electronic equipment design. Various types of foams are discussed and application methods are described. Property data are included for typical compounds. Selected case histories are illustrated.

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Vacuum-Molded Epoxy Cast-Resin Applications, H. R. Lucas Design of instrument transformers is improved through application of an integrally molded and impregnated epoxy resin insulation structure. Details of a low-pressure vacuum-molding technique are given and the advantages summarized.	Apr	98
Miscellaneous		
Winding Machine for Small Stators, F. Davis	Nov	162
Control Panel Layout to JIC Standards, F. R. Carlson Procedures to follow in laying out control panels to meet JIC Electrical Standards. The use of transparent templates in making the drawings is also described.	May	125
Printed Wiring		
Check for Accuracy of Printed Circuit Transparencies, C. J. Taylor Dimensional and exposure accuracy of printed circuit transparencies can be checked conveniently and rapidly. A checking technique employing reduced negatives and the moire effect is outlined.	Sep	123
Miniaturized Printed Circuit Fabrication, Robert E. Overas State of the art report describes capabilities of representative printed circuit fabricators to produce extremely fine conductors with small inter-conductor spacings. Special quality control measures are proposed.	Apr	137
TESTING		
Components		
Testing Component Linearity by "Least Squares," R. D. Moore The method of least squares applied to linearity testing of transducers such as potentiometers, synchros and resolvers. It may also be used in testing complete systems and loops.	Oct	110
Special Oil Used in Testing Super-Power Klystrons, J. D. Bianco	Aug	132
Procedures for Testing A-C Solenoids, D. O. Myers and I. Gebel The characteristics by which a-c solenoids should be rated for users in the industrial and home appliance fields are defined and test procedures to meet those characteristics are developed.	May	92
Applying the Hall Effect to Practical Magnet Testing, Gerhard R. Hennig Indium-arsenide probes that generate Hall voltages linear within ±1 per cent in magnetic fields up to 10,000 oersteds promise simplified precision magnetic measurements such as: air-gap flux densities and flux distribution patterns; long axial fields; coercivity; detecting inhomogeneities; *B-H* points and hysteresis loops; magnet assembly calibration.	Apr	132
Input Simulation for Servo Test Accuracy, Stanley Handelman For testing of servo systems and other measurements in which the input signal is a voltage analog of angular position, a resistance network can simulate a high precision synchro or resolver and dividing head. The development of the network, the requirements for the auxiliary null-detection equipment and other uses for the resulting synthesized signal are described.	Feb	104
Environmental		
The Space Environment, A Preliminary Study, R. A. Di Taranto and J. J. Lamb Analysis of natural environments in space (above 75,000 ft) as they affect future equipment design. Anticipated values are established for atmospheric composition, pressure, solar radiation, ozone, dissociated gases, aurorae, ionized gases, solid particles and the earth's magnetic field.	Oct	54
Altitude Chamber Relative Humidity, E. J. Burns	Oct	126
Materials		
Gaseous Dielectric Materials — Applications and Test Methods, M. L. Manning and E. D. Padgett Application areas for gaseous (dry) dielectrics are tabulated. Fluorogases are briefly reviewed. Existing test methods for measuring breakdown voltage are described. A new high-temperature test cell is discussed and various breakdown data are presented and interpreted.	Oct	86
R-F Permeameter Techniques for Testing Ferrite Cores, A. L. Rasmussen and A. E. Hess Equipment, equations and typical results for testing toroidal samples of commercially available ferromagnetic materials; complex initial permeability measurements over frequency range 20 kc to 50 mc, temperature dependence of r-f permeability measurements from room temperature to over 275 C, and reversible permeability measurements with parallel d-c biasing fields up to 12 oersteds.	May	86
Thermal Evaluation of Electrical Insulation as a Design Tool, J. F. Dexter Major procedures for evaluating thermal stability of electrical insulating materials to meet design requirements are discussed in terms of materials tests, systems tests and equipment tests. Development of standard test procedures is traced; significance of various functional tests is analyzed. Typical test procedures are described for various classes of insulating materials.	Mar	88
Microwave Properties of Solid Dielectrics up to 3000 F, D. M. Bowie Article describes measurement of dielectric constant and loss of solid dielectric at 3000 mc/sec with apparatus able to yield nearly uniform accuracy from room temperature to 3000 F. Measurements on high-alumina materials show practical temperature limits of operation as dielectrics at the frequency employed. Results on thermosetting laminates indicate temperature limits above which irreversible changes in dielectric properties occur.	Feb	144
Production		
Automatic Testing, Data Recording, and Statistical Analysis System, E. Hoo Description of the Astramatic system designed for automatic handling, testing, sorting of components, and automatic accumulation and analysis of statistical data. Test data are recorded on punched tape and automatically plotted as a histogram.	Jan	104
Systems		
Final Performance Testing of a Large Guided Missile, R. L. Smith, Jr. Final electrical and electromechanical testing of the Jupiter missile at Redstone Arsenal is described. Test equipment and facilities are illustrated and general procedures followed for preliminary system checkout and final simulated flight tests are outlined.	Dec	46
Radio Noise Measurement, H. J. Tyzzer Conducted and radiated interference measurements, instrument characteristics and response standards are reported for a series of radio noise meters.	Nov	93
Testing Component Linearity by "Least Squares," R. D. Moore The method of least squares applied to linearity testing of transducers such as potentiometers, synchros and resolvers. It may also be used in testing complete systems and loops.	Oct	110
Input Simulation for Servo Test Accuracy, Stanley Handelman For testing of servo systems and other measurements in which the input signal is a voltage analog of angular position, a resistance network can simulate a high precision synchro or resolver and dividing head. The development of the network, the requirements for the auxiliary null-detection equipment and other uses for the resulting synthesized signal are described.	Feb	104

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Appearance	Design Considerations
Appliance Design	Product Design Case History
Automatic Assembly	Production and Assembly Techniques
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Bearings	Components, Mechanical/Structural
Boolean Algebra	Control (*Theory*)
Brushes	Components, Electrical/Electronic (*Contact Devices*)
Business Machines Design	Product Design Case History (*Electronic Apparatus*)
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Ceramic-Metals	Materials, Mechanical/Structural (*Composite Materials*)
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Insulation Testing	Testing (*Materials*)
Integral-Horsepower Motors	Motors
International Standards	Design Considerations (*Specifications and Standards*)

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Liquid Dielectrics	Materials, Electrical/Electronic (*Electrical Insulation and Dielectrics*)
Lubricants	Materials, Mechanical/Structural (*Nonmetallic Materials*)
M	
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Magnetic Core Memories	Components, Electrical/Electronic (*Storage Devices*)
Magnetic Materials	Materials, Electrical/Electronic
Magnetic Recording	Components, Electrical/Electronic (*Transducers*)
Magnet Wire	Components, Electrical/Electronic (*Wire and Cables*)
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Plastics, Fabricated	Materials, Mechanical/Structural (*Nonmetallic Materials*)
Plastics, Insulation	Materials, Electrical/Electronic (*Electrical Insulation and Dielectrics*)
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Relays	Components, Electrical/Electronic (*Magnetic Components*)
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Thermostats	Components, Electrical/Electronic (*Transducers*)
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Wire Enamel and Insulation	Materials, Electrical/Electronic (*Electrical Insulation and Dielectrics*)
Wiring Devices	Components, Electrical/Electronic
Wiring Harness	Components, Electrical/Electronic (*Wire and Cables*)

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- Joint Industry Conference
- NEMA Activities

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- Mathematics
- Physics

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- Potentiometers
- Printed Circuits
- Protective Devices
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- Fractional-Horsepower
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- Automatic Assembly
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- Hermetic Sealing
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- Printed Wiring
- Soldering and Solderless Techniques
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Testing
- Components
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